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European Patent Office
D-80298 Munich
Germany

Authorized Officer: Koegler-Hoffmann, S

Re: International Application No. PCT/US03/26329
E. I. du Pont de Nemours and Company
Our Ref.: CH2894PCT

Dear Sir or Madam:

Responding to the written opinion mailed 11/05/2004, applicant submits the following amended claims and substitute pages 14-15.

Mark-Up Version of Amended Claims

1. A composition comprising a fiber which comprises or has coated thereon a thin film wherein said thin film has a thickness of less than 1000 nm, preferably less than 500 nm, and comprises or is produced from a fluorocarbon silane or an emulsion, said emulsion comprises or is produced from (1) a fluorocarbon silane or its hydrolyzate, (2) water, and (3) optionally a surfactant, an alkoxysilane compound, catalyst, or combinations of two or more thereof; said fluorocarbon silane ~~having~~ has the formula R_f-$(CH_2)_p$-$Si\{-(O-CH_2CH_2)_n-OR^1\}_3$; R_f is a C_{3-18} perfluoroalkyl group or combinations of two or more thereof; each R^1 is independently one or more C_{1-3} alkyl groups; p is 2 to 4; and n is 2 to 10.

2. The composition of claim 1 wherein said thin film further comprises, or is produced from, a copolycondensate of said fluorocarbon silane, said surfactant, and ~~an~~ said alkoxysilane.

~~3. The composition of claim 1 or 2 wherein said thin film has a thickness of less than 1,000 nm, preferably less than 500 nm.~~

43. The composition of claim 1 or 2 ~~, 2, or 3~~ wherein said fiber is an aromatic polyamide fiber, an aromatic polyester fiber, a heterocyclic aromatic fiber, or combinations of two or more thereof.

~~5~~4. The composition of claim 43 wherein said fiber is a p-phenylene terephthalamide fiber.

~~6~~5. A textile product comprising or produced from a fiber wherein said fiber is as recited in claim 1, 2, 3, or 4~~, or 5~~.

~~7~~6. The product of claim ~~6~~5 wherein said product is a woven product, a knit product, a nonwoven fabric, or combinations of two or more thereof; and is preferably a woven fabric for protective clothing, a firefighting apparel, or a glove.

~~8~~7. A process comprising (1) combining a fluorocarbon silane or its hydrolyzate, water, and optionally a surfactant, an alkoxysilane compound, catalyst, or combinations of two or more thereof to produce a mixture; (2) ~~and~~ optionally heating said mixture to produce an emulsion; and (3) producing a thin film of said emulsion onto a fiber wherein said thin film has a thickness of less than 1000 nm, preferably less than 500 nm; said thin film is as recited in claims 1, 2, 3, or 4; ~~wherein~~ said fluorocarbon silane having the formula R_f-$(CH_2)_p$-$Si\{-(O-CH_2CH_2)_n-OR^1\}_3$; R_f is a C_{3-18} perfluoroalkyl group or combinations of two or more thereof; each R^1 is independently one or more C_{1-3} alkyl groups; p is 2 to 4; and n is 2 to 10.

~~9. The process of claim 8 further comprising producing a thin film of said emulsion onto a fiber wherein said thin film has a thickness of less than 1000 nm, preferably less than 500 nm; and said thin film is as recited in claims 1, 2, 3, 4, or 5.~~

~~10~~8. The process of claim ~~9~~7 wherein said fiber is an aromatic polyamide fiber, an aromatic polyester fiber, a heterocyclic aromatic fiber, or combinations of two or more thereof.

~~11~~9. The process of claim ~~10~~8 further comprising producing a woven product, a knit product, a nonwoven fabric, or combinations of two or more thereof.

The Invention

The claims are directed to a fiber or textile product coated with a very thin film layer of a fluorocarbon having excellent heat resistance and durability as well as excellent stain-proofing performance. The thin film has a thickness less than 1000nm and demonstrates heat-resistance and durability.

D1- WO9523804(A1)

Novelty - Amended claims 1 and 7, which include the limitation of film thickness of less than 1,000 nm, are novel over D1. As the examiner noted, D1 does not disclose the thickness of a thin film on a substrate. The examiner merely *assumed* that the thickness of the film produced in D1, Example 12, would be the same.

There are no references showing that a thin film of less than 1,000 nm can be or has ever been produced. Applicant discloses in the "Background of the Invention" (last paragraph bridging pages 1 and 2) that

> While it is also possible to individually coat each fiber or fiber bundle making up the textile product, when a polymer dispersion is used, a film of smaller thickness than the size of the particles in the dispersion cannot be formed. In most cases, the film has a thickness of at least several tens of microns, and also lacks adequate strength.

Amended claims 3 and 4 further provide novelty because the fibers specifically recited in amended claims 3 and 4 are not disclosed in D1.

As such, claims 1, 3(cancelled), and 6-8 (9 cancelled) are novel over D1.

Inventive Step – The examiner probably would agree that the thicker a coating cover is, the better heat resistance the coating cover would be because it is logical, and a conventional thinking, to one skilled in the art. That is, in a very thin film coating, the coating may not be very thermal stable or heat resistant. However, the present invention demonstrates that a thin film coating can be very heat resistant. This is shown in Table 2 (page 12) of the application where it demonstrates that a thin film at 250°C for 24 hours maintains its water repellency (128 compared to original 127).

D1 does not suggest that a very thin film of less than 1000 nm would have a thermal stability and, at such high temperature of 250°C for 24 hours, would maintain the repellency.

The examiner suggested that Example 12 of D1 is similar to the claimed invention. Applicant respectfully disagrees. Example 12 does not disclose or suggest a thin film layer. Example 12 does not suggest heating at a high temperature for a prolonged period. Example 12 merely discloses one *dry cleaning* cycle. Dry cleaning involves use of solvent and has little or no heat.

The examiner also noted that D1 discloses that typical treatable substrates are wood, brick, . . . , natural and synthetic fibers, fur and leather (page 9, lines 1-2). However, D1 does not suggest a thin film having a thickness of less than 1000 nm.

Applicant also discloses a problem to be solved on page 2, lines 4-9:

> As a result, when the fibers are individually coated with such a coating agent, the coat has a certain thickness, which compromises the hand of the fibers and the textile product. There also exists a thin film-forming method which uses a liquid-type coating, and subjects a polymer precursor on the fiber surface to polymerization and solidification. Unfortunately, it is difficult to obtain a thin film of sufficient durability in this way.

The compromise of the hand of the fiber is also disclosed on page 1, lines 23-25 that . . . the film produced . . . resulted in a considerable loss in the inherent hand of the fibers.

D1 does not disclose or suggest such a problem.

Therefore, claims 1, 3-8 and 10-11 (substitute claims 1, 3-7 and 8-9) are inventive.

D2- WO0231062(A2, A3)

D2 does not disclose or suggest coating a thin film of less than 1000 nm on fiber that has unexpected thermal stability and repellency. Nor does D2 disclose or suggest the problem facing applicant, as disclosed above. Therefore, claims 1, 2, and 8 (now 7) are novel and inventive.

D3- WO0190267(A2, A3)

For the same reasons as discussed above, claims 1, 2, and 8 (now 7) are novel and inventive over D3.

Respectfully submitted,

Lucas K. Shay
Telephone: 302-992-6154
Fax No.: 302-892-7925

Enc.

CLAIMS

1. A composition comprising a fiber which comprises or has coated thereon a thin film wherein said thin film has a thickness of less than 1000 nm, preferably less than 500 nm, and comprises or is produced from a fluorocarbon silane or an emulsion, said emulsion comprises or is produced from (1) a fluorocarbon silane or its hydrolyzate, (2) water, and (3) optionally a surfactant, an alkoxysilane compound, catalyst, or combinations of two or more thereof; said fluorocarbon silane has the formula R_f-$(CH_2)_p$-$Si\{-(O-CH_2CH_2)_n-OR^1\}_3$; R_f is a C_{3-18} perfluoroalkyl group or combinations of two or more thereof; each R^1 is independently one or more C_{1-3} alkyl groups; p is 2 to 4; and n is 2 to 10.

2. The composition of claim 1 wherein said thin film further comprises, or is produced from, a copolycondensate of said fluorocarbon silane, said surfactant, and said alkoxysilane.

3. The composition of claim 1 or 2 wherein said fiber is an aromatic polyamide fiber, an aromatic polyester fiber, a heterocyclic aromatic fiber, or combinations of two or more thereof.

4. The composition of claim 3 wherein said fiber is a p-phenylene terephthalamide fiber.

5. A textile product comprising or produced from a fiber wherein said fiber is as recited in claim 1, 2, 3, or 4.

6. The product of claim 65 wherein said product is a woven product, a knit product, a nonwoven fabric, or combinations of two or more thereof; and is preferably a woven fabric for protective clothing, a firefighting apparel, or a glove.

7. A process comprising (1) combining a fluorocarbon silane or its hydrolyzate, water, and optionally a surfactant, an alkoxysilane compound, catalyst, or combinations of two or more thereof to produce a mixture; (2) optionally heating said mixture to produce an emulsion; and (3) producing a thin film of said emulsion onto a fiber wherein said thin film has a thickness of less than 1000 nm, preferably less than 500 nm; said thin film is as recited in claims 1, 2, 3, or 4; said fluorocarbon silane having the formula R_f-$(CH_2)_p$-$Si\{-(O-CH_2CH_2)_n-OR^1\}_3$; R_f is a C_{3-18} perfluoroalkyl group or combinations of two or more thereof; each R^1 is independently one or more C_{1-3} alkyl groups; p is 2 to 4; and n is 2 to 10.

8. The process of claim 7 wherein said fiber is an aromatic polyamide fiber, an aromatic polyester fiber, a heterocyclic aromatic fiber, or combinations of two or more thereof.

9. The process of claim 8 further comprising producing a woven product, a knit product, a nonwoven fabric, or combinations of two or more thereof.